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THE MEGACHILID BEES OF THE PHILIPPINE ISLANDS

By T. D. A. COCKERELL
(*University of Colorado*)

The present account is entirely based on a very fine series of specimens sent by Professor C. F. Baker and on the comparatively few published records that existed prior to the formation of the Baker collections. Several islands are represented, but of course our knowledge of the bee fauna of the Philippines is still very incomplete. In the case of the Megachilidæ, many of which nest in wood, it is very likely that some of the species have been distributed through the agency of man and do not belong to the original fauna of localities where we now find them.

The genus *Ctenoplectra* Smith, which Ashmead included in the Megachilidæ, is an isolated type not at all referable to that family. The one Philippine species is *C. vagans* Cockerell.[1] Baker obtained it on Mount Maquiling. It will be readily known by the two submarginal cells and the shining blue abdomen. The lateral ocelli are more or less aborted. The Philippine genera of Megachilidæ, all of which have only two submarginal cells in the anterior wings, are readily separable as follows:

Key to the Philippine genera of the Megachilidæ.

Eyes hairy; female abdomen usually conical or pointed at end, male abdomen spinose at end; parasitic bees, without pollen-collecting apparatus. **Coelioxys** Latreille.

Eyes not hairy ..... 1.

1. Female like *Megachile*, but wholly without ventral scopa, and antennæ 13-jointed ..... **Androgynella** Cockerell.

Female with a ventral scopa (pollen-collecting brush) on abdomen ..... 2.

[1] *Ann. & Mag. Nat. Hist.* (1904), VII, 14, 204, and (female) (1914), VIII, 13, 280.

2. With yellow or reddish tegumentary markings; foot with a pulvillus, or pad, between the claws ..... Dianthidium Cockerell.
   Without pale tegumentary markings ..... 3.
3. Very small bees, with a pulvillus between the claws; face with no protuberance; ventral scopa white ..... Heriades Spinola.
   Larger bees; or, if small, without any pulvillus ..... 4.
4. Marginal cell sharply pointed at end; face, in female, with a protuberance, end of male abdomen pointed ..... Lithurgus Berthold.
   Marginal cell obtuse at end; end of male abdomen variously formed; no pulvillus on foot ..... Megachile Latreille.

Genus COELIOXYS Latreille

These bees are parasitic in the nests of *Megachile*. The species at present known from the Philippines are separable thus:

Key to the Philippine species.

Very large, the female about 22 millimeters long; head with fulvous pubescence; wings very dark ..... ducalis Smith.
Under 20 millimeters, but female at least 13 millimeters; face with a median keel; hair of head white, at most slightly stained with fulvous. philippensis Bingham.
Much smaller ..... 1.
1. Females ..... 2.
   Males ..... 4.
2. Apex of abdomen obtuse ..... 3.
   Apex of abdomen produced, acute ..... genalis Cockerell.
3. Apical ventral plate of abdomen truncate; thorax above with fulvous hair markings ..... manilæ Ashmead and bakeri Cockerell.
   Apical ventral plate subangular, emarginate; markings on thorax white. cothura Cockerell.
4. Legs red; pubescence fulvescent ... manilæ Ashmead and bakeri Cockerell.
   Legs black ..... 5.
5. Punctures of mesothorax extremely dense; two bright hair spots at base of scutellum ..... luzonicus Cockerell.
   Punctures of disk of mesothorax distinctly separated ..... 6.
6. Mesothorax anteriorly with a conspicuous fulvous triangle of hair. bakeri var. atripes Cockerell.
   Mesothorax without such a triangle ..... 7.
7. Tegulæ black or piceous ..... genalis Cockerell.
   Tegulæ rufous; very small, a little over 6 millimeters long. dapitanensis Cockerell.

Coelioxys ducalis Smith.

Coelioxys ducalis SMITH; COCKERELL, Ann. & Mag. Nat. Hist. (1914), VIII, 13, 146.

Bingham gives a colored figure of this species.[2]

LUZON, Laguna, Los Baños (*Baker*). Friese describes a subsp. *flavipennis* from Celebes.

[2] Fasciculi Malayenses, Zoology (1905), 3, Pl. A.

Coelioxys philippensis Bingham.

Cœlioxys philippensis BINGHAM, Ann. & Mag. Nat. Hist. (1895), VI, 16, 439.

The unusual form of the specific name must be maintained as printed. I examined Bingham's type in the British Museum.

LUZON, Laguna, Los Baños and Mount Maquiling (*Baker*).

Coelioxys bakeri Cockerell.

Coelioxys bakeri COCKERELL, Entomologist (1915), 108.

MINDANAO, Iligan, Dapitan, and Davao (from *Baker*). Type from Iligan.

Coelioxys bakeri var. atripes var. nov.

Legs black. Male from Los Baños, Luzon (*Baker*).

Coelioxys manilæ Ashmead.

Coelioxys manilæ ASHMEAD, Canadian Entomologist (1904), 36, 281; COCKERELL, Proc. U. S. Nat. Mus. (1909), 36, 415.

Ashmead's description is poor, but I saw his type a number of years ago in Washington and found the last dorsal segment of abdomen to be broadly rounded and obtuse, as in *C. bakeri* female. *Coelioxys bakeri* appears to differ from *C. manilæ* by the absence of a fulvous triangle on mesothorax, posteriorly, and the surface of the mesothorax shining between the punctures. The legs of *manilæ* are red, as in typical *bakeri*. The male of *manilæ* is unknown, but a male from Mount Maquiling, with the surface of mesothorax dull and red tarsi, but the legs otherwise black, is probably referable to *manilæ;* if not, it is a new species, for it is certainly distinct from *bakeri*.

Coelioxys genalis Cockerell.

Coelioxys genalis COCKERELL, Entomologist (1916), 49, 157.

Originally described from a male from Mount Maquiling. The female (Los Baños, *Baker 6306*) is 9 millimeters long; last dorsal segment of abdomen pointed, its apical half sharply keeled; last ventral pointed, notched at sides, extending beyond dorsal. This differs from the European *C. elongata* in the less-produced and much less parallel-sided last ventral. A female from Davao, Mindanao, is not separable. From Negros I have only a male, and it is separable from a Mount Maquiling male as follows:

Hair bands of abdomen white; superior apical spines farther apart. Mount Maquiling form

Hair bands of abdomen fulvous; superior apical spines nearer together. Negros form.

Additional material may indicate that the Negros insect is separable.

LUZON, Laguna, Mount Maquiling, Los Baños. MINDANAO, Davao. NEGROS, Cuernos Mountains. All from Baker.

Coelioxys cothura sp. nov.

Female.—Length, 9 millimeters; black, including the legs, antennæ, mandibles, and tegulæ; eyes brown, with short hair; a shining ridge or line on lower part of front, but none on clypeus, which is minutely granular; hair markings of head, thorax, and abdomen white, slightly stained with ocherous; cheeks densely covered with hair; mesothorax coarsely and closely punctured, with a triangle of white hair in front; scutellum rounded behind, axillar spines short; wings dilute brown; tarsi with fulvous hair on inner side; abdomen shining, the white hair bands linear in middle, broadly expanded at sides, on sixth segment forming a patch on each side; first segment strongly and closely punctured (but punctures smaller than on mesothorax); second with lateral grooves and large, well-separated punctures; third and fourth with smaller punctures and transverse, smooth raised bands; fifth and sixth with extremely minute punctures, but the sixth with large coarse punctures apically; apical end of sixth rounded and obtuse; last ventral extending a little beyond, very broad, subangular and emarginate at end; venter with broad white hair bands on segments 2 to 5, but first segment with only a large median patch, which extends from base to apex. The last dorsal has only a faint indication of a keel.

LUZON, Laguna, Los Baños (*Baker*). By the structure of the end of the abdomen, this is associated with such species as *C. afra, C. emarginata,* and *C. hæmorrhoa.*

Coelioxys luzonicus Cockerell.

Coelioxys luzonicus COCKERELL, Entomologist (1914), 118.

LUZON, Laguna, Los Baños (*Baker*).

Coelioxys luzonicus makilingensis Cockerell.

Coelioxys luzonicus makilingensis COCKERELL, Entomologist (1915), 108.

Male a little over 8 millimeters long, differing from typical *luzonicus* thus: Mesothorax anteriorly (but not posteriorly) with a rather large triangle of pure white hair; oblique hair marks on scutellum larger, pure white; spot above posterior end of tegulæ pure white; first recurrent nervure joining second submarginal cell very close to basal corner; upper apical teeth of abdomen longer and not on the same horizontal plane, the inner on each side being higher than the outer, which is not true of

luzonicus. Perhaps a distinct species. The Davao male has brown eyes, the Luzon form has them green.

LUZON, Laguna, Mount Maquiling. MINDANAO, Davao (*Baker 7458*). The spelling of the name must be kept as first printed, following the name of the locality as given on Baker's labels, but Maquiling appears to be the official spelling of the name of the mountain.

Coelioxys dapitanensis Cockerell.

Coelioxys dapitanensis COCKERELL, Entomologist (1915), 109.

MINDANAO, Dapitan (*Baker 3152*). PALAWAN, Puerto Princesa (from *Baker*).

Genus **DIANTHIDIUM** Cockerell

The species of this genus make nests of resin and pebbles.

Dianthidium minutissimum (Bingham).

Dianthidium minutissimum (BINGHAM) COCKERELL, Entomologist (1917), 164.

PALAWAN, Puerto Princesa (from *Baker*). *Anthidium javanicum* Friese, from Java, is the same species. Bingham gives a colored figure of this species.[3]

Genus **LITHURGUS** Berthold

Lithurgus scabrosus (Smith).

Lithurgus scabrosus (SMITH) MEADE-WALDO, Ann. & Mag. Nat. Hist. (1912), VIII, 10, 463.

MINDANAO, Dapitan and Davao. The British Museum has it from Rarotonga, Celebes, and Amboina. The ventral scopa of the female is long and rather thin, black. This is Baker's No. 3135.

Genus **MEGACHILE** Latreille

These are the leaf-cutting bees; occasionally they are so abundant as to be injurious. The Philippine species are separable as follows:

Key to the Philippine species.

Females ..... 1.
Males ..... 15.
1. Ventral scopa black ..... 2.
Ventral scopa paler or red, or only partly black ..... 5.
2. Clypeus very short and strongly tuberculate in middle; insect very large, considerably over 20 millimeters long (subgenus *Eumegachile* Friese) ..... 3.
Clypeus not thus formed ..... 4.

[3] Fasciculi Malayenses, Zoology (1905), 3, Pl. A.

3. Wings dark fuliginous ..... clotho Smith.
   Wings yellowish ..... tuberculata Smith.
4. Fully 20 millimeters long; wings dark fuliginous; upper edge of clypeus straight ..... atrata Smith and lachesis Smith.
   Much less than 20 millimeters long; wings translucent reddish; upper edge of clypeus concave ..... davaonensis Cockerell.
5. Over 15 millimeters long, with a large flattened, polished, triangular supraclypeal space ..... bakeri Cockerell.
   Under 15 millimeters long; wings never dark fuliginous ..... 6.
6. Middle and hind femora red; ventral scopa white or cream-colored, black on last segment ..... 7.
   Legs black ..... 8.
7. Larger; ocelli very large ..... ocellifera Cockerell.
   Smaller; ocelli small ..... tarsatula Cockerell.
8. Scopa white, black on last two segments; hair on tubercles fulvous; abdomen metallic ..... metallescens Cockerell.
   Scopa, at least mainly or largely, ferruginous or orange or yellow ..... 9.
9. Abdomen with orange-fulvous hair bands; a shining polished area on upper part of clypeus and lower part of supraclypeal area. rufofulva Cockerell.
   Abdomen with pale (sometimes yellowish) hair bands ..... 10.
10. Scopa with hair on last segment at least mainly red ..... 11.
    Scopa with hair on last segment black ..... 12.
11. Larger; abdomen with strong green and purplish tints. chlorura Cockerell.
    Smaller; abdomen not metallic ..... hera Bingham.
12. Scutellum with black or dark fuscous hair ..... 13.
    Scutellum with ocherous or fulvous hair ..... 14.
13. Scutellum with long black hair; pale hair of face white. philippinensis Friese.
    Scutellum with shorter black or dark fuscous hair; pale hair of face fulvous; mandibles longer ..... valdezi Cockerell.
14. Scutellum with short ocherous or whitish hair; scopa more brightly colored and mesothorax more densely punctured than in *valdezi*. subrixator Cockerell.
    Similar to *subrixator*, but tegulæ red with black basal spot; face covered with fulvous pubescence; scopa very pale fulvous, black at tip. robbii Ashmead.
15. Abdomen densely covered with orange-fulvous tomentum; disk of clypeus with black hair, but its lower margin with a long white fringe. albobarbata Cockerell.
    Abdomen not thus colored ..... 16.
16. Abdomen coal-black, with short black hair; insect at least 13 millimeters long ..... 17.
    Abdomen not thus black-haired, or, if appearing dark, insect much smaller ..... 18.
17. Sides of front with white hair ..... lachesis Smith.
    Sides of front with black hair ..... lachesis nigrolateralis Cockerell.
    Sides of front with black hair, but insect much larger; fully 20 millimeters long; wings very dark ..... clotho Smith.

18. Tarsi red ..... tarsatula Cockerell.
Tarsi dark, except for the hair..... 19.
19. Anterior tarsi modified, with a yellow boat-shaped process.
navicularis Cockerell.
Anterior tarsi without such a process..... 20.
20. Anterior tarsi broadened, ferruginous..... structilis Cockerell.
Anterior tarsi black..... 21.
21. Anterior and middle tarsi with long white hair behind.... laticeps Smith.
Anterior tarsi simple, ordinary..... 22.
22. Sixth abdominal segment above without light tomentum, or (*candentula*) only with red hair at sides..... 23.
Sixth abdominal segment above with light tomentum..... 25.
23. Fifth abdominal segment covered with red tomentum.
candentula Cockerell.
Fifth abdominal segment without red tomentum..... 24.
24. Hair of scutellum black ..... merrilli Cockerell.
Hair of scutellum ocherous..... mcgregori Cockerell.
25. Hair of head and thorax above largely black, that on scutellum long.
philippinensis Friese.
Like the last, but the dense tomentum of abdominal bands and sixth segment golden fulvous; mandibles with three large teeth and a small tooth between first and second ..... philippinensis vizcayana Cockerell.
Hair on head and thorax above largely black or dark fuscous, but relatively short on scutellum; mesothorax glistening.. valdezi Cockerell.
Hair on head and thorax above ocherous (rarely a little fuscous); mesothorax dull ..... subrixator Cockerell.

Megachile clotho Smith.

Megachile clotho SMITH; COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 266.

MINDANAO, Dapitan (from *Baker*). Brown [4] listed the species from the Philippines, without particulars.

Megachile tuberculata Smith.

Megachile tuberculata SMITH, Journ. Linn. Soc. London (1858), 2, 46.
Megachile longipalpis RADOSZKOWSKI, Wiadom. z. nauk. przyrodz. Warszow (1882), 2, 79.

Female, 26 millimeters long. According to Friese *longipalpis* is the same as *tuberculata*, and there seems to be nothing in the descriptions to indicate the contrary. *Megachile tuberculata* was originally described from Sarawak; *M. longipalpis* is recorded from the Philippines.

Megachile atrata Smith.

Megachile atrata SMITH, Cat. Hym. Brit. Mus. (1853), 1, 182; ASHMEAD, Proc. U. S. Nat. Mus. (1904), 28, 149.

[4] *This Journal* (1906), 1, 606.

Originally described from the Philippine Islands, the particular island not mentioned. My specimen, from F. Smith's collection, was obtained in Amboina.

Megachile lachesis Smith.

Megachile lachesis SMITH, Journ. Linn. Soc. London (1861), 5, Suppl., 133; BROWN, Phil. Journ. Sci. (1906), 1, 686.

Described from Batchian and Amboina. Possibly the typical form does not occur in the Philippines. My specimen is from Bismarck Archipelago.

Megachile lachesis nigrolateralis Cockerell.

Megachile lachesis nigrolateralis COCKERELL, Ann. & Mag. Nat. Hist. (1914), VIII, 13, 279.

LUZON, Laguna, Los Baños (*Baker*). Only the male is known.

Megachile davaonensis sp. nov.

Female.—Length, about 15 millimeters; entirely black, with short black hair, but the tubercles posteriorly fringed with white tomentum; face broad, eyes converging slightly above; mandibles with a broad cutting edge, on which are only two salient teeth; clypeus short and broad, rugose all over, but glistening, the lower margin with two widely separated small teeth; front densely rugose–punctate; vertex with very large punctures on a shining ground; cheeks sharply carinate posteriorly; mesothorax and scutellum very coarsely punctured, the punctures more or less confluent in a transverse direction; tegulæ black; wings reddish translucent, stigma and nervures ferruginous; hind basitarsi not enlarged; abdomen with short black tomentum and the scopa black.

MINDANAO, Davao (from *Baker*). Looks like an undersized *M. atrata* var. *fulvipennis* Smith; but the clypeus and the mandibles are very different, and the wings are duskier.

Megachile bakeri sp. nov.

Female.—Length, about 16 millimeters; black, with the ventral scopa light fulvous, black on last two segments; mandibles with a very long cutting edge, two obtuse apical teeth, and the rest of the margin with a strong double curve, but not dentate; disk of clypeus and of supraclypeal area (which is flattened) polished and sparsely punctured; front and vertex with dark chocolate-colored hair, sides of face and lower part of cheeks with white hair; vertex with minute dense punctures in middle and scattered punctures at sides; eyes olive green; mesothorax dullish, with dense round punctures, not confluent;

thorax above with thin, short black hair, sides of metathorax with long and abundant cream-colored hair, tubercles fringed with light tomentum, prothorax and lower part of pleura with creamy white hair; tegulæ black; wings dusky reddish, apical margin darker; nervures and stigma piceous; legs stout, with pale hair, red on inner side of tarsi; hind basitarsi greatly broadened, longer than the remaining joints together; spurs ferruginous; abdomen finely punctured, with distinct green and purplish tints; no hair bands, but segments 1 to 4 with white fringes at sides; fifth segment dull and granular, with thin, short black hair.

LUZON, Laguna, Mount Maquiling (*Baker*). A very fine species, the smooth shining area on the face resembling the Bornean *M. shelfordi* Cameron, but that has a black scopa.

Megachile ocellifera sp. nov.

Female.—Length, about 10 millimeters; black, with the greater part of middle and hind coxæ and femora, large patch on hind tibiæ posteriorly, and base of abdominal venter all bright ferruginous; ventral scopa pale yellowish, black on last segment; clypeus densely and coarsely punctured; sides of face with conspicuous white hair; head and thorax above with short black hair; ocelli extremely large, especially the lateral ones; mesothorax strongly and quite densely punctured; pleura with thin pale hair; tegulæ black; wings dusky translucent; hind basitarsi broadened; abdomen with five linear white hair bands; disks of the segments conspicuously, transversely sulcate.

MINDANAO, Davao (from *Baker*). In all respects very close indeed to *M. tarsatula*, but easily separated by the immense ocelli, which suggest that it is a nocturnal species.

Megachile tarsatula Cockerell.

Megachile tarsatula COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 530; Entomologist (1916), 159.

NEGROS, Cuernos Mountains (type locality). MINDANAO, Dapitan and Davao (from *Baker*). PALAWAN, Puerto Princesa (from *Baker*).

Megachile metallescens sp. nov.

Female.—Length, about 12.5 millimeters; black, including the mandibles, legs, and antennæ; but the tegulæ are bright ferruginous, while the shining dorsal surface of the abdomen has strong blue and coppery tints; mandibles with four subequal teeth; eyes reddish; cheeks angulate behind; clypeus rough and

coarsely punctured, but with a polished area on its upper part; sides of face conspicuously tufted with fulvous hair; mesothorax and scutellum brilliantly polished, strongly but not very closely punctured, scutellum with a shining impunctate area anteriorly; hair of mesothorax pale, short, and scanty; disk of scutellum with fuscous hair, but postscutellum, sides of metathorax, and tubercles with long pale fulvous hair; pleura with thin brownish white hair; base of metathorax with a median pit; wings dusky, stigma and nervures dusky red; legs with thin pale hair, reddened on inner side of tarsi; hind basitarsus only moderately broad; abdomen with pale fulvous hair on first segment; segments 2 to 4 with shaggy white hair bands, weak or interrupted in the middle; ventral scopa white, black on last two segments.

LUZON, Laguna, Mount Maquiling (*Baker 7454*). In Friese's table of Oriental species this runs near *M. umbripennis*, but it is quite distinct.

Megachile rufofulva sp. nov.

Female.—Length, nearly 12 millimeters, rather slender; black, including mandibles, antennæ, and legs; mandibles tridentate, the third tooth very broad; clypeus densely rugose, with a T-shaped polished shining area, the transverse part of which is partly supraclypeal; vertex closely punctured; cheeks with white hair; clypeus with black hair, but on each side of it there is white; front with mixed black and white, vertex with black hair; mesothorax and scutellum shining but closely punctured, with short black hair on disk, but grayish white on side of mesothorax and a line of white in scutello-mesothoracic suture; pleura and tubercles with white hair, but that on postscutellum and metathorax creamy or suffused with fulvous; tegulæ small, dark brown; wings dusky translucent; hind basitarsi very broad, with red hair on inner side; anteriorly the hind tibiæ and tarsi have stiff glittering white hair, forming a fringe; abdomen finely roughened, the hind margins of the segments with fulvous hair bands, on fourth and fifth segments the fulvous hair covering over half the surface, sixth with fine, appressed, pale fulvous hair; ventral scopa bright ferruginous, cream-colored at extreme base.

MINDANAO, Zamboanga (from *Baker*). Allied to the Bornean *M. tarea* Cameron, but distinct; our species has only a very small red projection at apex of anterior tibiæ, and the legs are not covered with fulvous hair.

Megachile chlorura sp. nov.

Female.—Length, about 13 millimeters; black, including

mandibles, legs, and antennæ, but abdomen above with strong green and steel-blue tints; mandibles tridentate, the third tooth very broad and low; eyes brown; cheeks covered with white hair; face and front with white hair; long, slightly creamy hairs converging from each side to middle of clypeus; a polished shining space on upper part of clypeus and supraclypeal area; thorax with white hair, abundant at sides and behind, but very thin above; a little, short fuscous hair on mesothorax; mesothorax polished, sparsely punctured; scutellum impunctate anteriorly, densely punctured posteriorly, tegulæ black, wings hyaline, apical margin broadly dusky; nervures piceous; legs with pale hair, orange-fulvous on inner side of tarsi, hind basitarsi broad; abdomen with a dense patch of white hair on each side of first segment and weak white hair bands on second and fifth; ventral scopa bright ferruginous.

LUZON, Laguna, Mount Maquiling (*Baker 7455, 7456*). Related to the Australian *M. pictiventris* Smith, but the latter has a quantity of black hair on head and thorax.

Megachile hera Bingham.

Megachile hera BINGHAM, Faun. Brit. India, Hymenoptera (1897), 1, 489; BROWN, Phil. Journ. Sci. (1906), 1, 686.

LUZON, Laguna, Mount Maquiling (from *Baker*). This species was described from Tenasserim; I have not seen types or topotypes, but the specimens before me agree with Bingham's description. The species is certainly very close to *M. subrixator*.

Megachile philippinensis Friese.

Megachile philippinensis FRIESE; COCKERELL, Entomologist (1916), 159.

LUZON, Laguna, Los Baños (type locality) and Mount Maquiling: Nueva Vizcaya, Imugan: Benguet, Baguio. MINDANAO, Dapitan. PALAWAN, Puerto Princesa. All from Baker. Allied to *M. tranquilla* Cockerell, from Formosa.

Megachile philippinensis var. **vizcayana** var. nov.

Male.—Length, about 8 millimeters; the three broad abdominal bands, and hair on upper side of sixth segment, golden fulvous; mandibles with four teeth, the fourth largest, the second very small. It is larger than typical males.

LUZON, Nueva Vizcaya, Imugan (from *Baker*).

Megachile valdezi (Cockerell).

Megachile abluta valdezi COCKERELL, Entomologist (1916), 159.

LUZON, Laguna, Mount Maquiling (type locality). MINDANAO, Zamboanga and Davao (from *Baker*). In the original

description it was stated that the ventral scopa was white, black on last segment; however, with a compound microscope it can be seen that the hair is orange subapically. The Davao females have the scopa (except basally and apically) very bright orange-fulvous and approach *M. subrixator*. *Megachile valdezi* and *subrixator* are very closely related and may be only races of one species. I formerly referred both to the Formosan *M. abluta* Cockerell as races.

Megachile subrixator (Cockerell).

Megachile abluta subrixator COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 535.

MINDANAO, Iligan (type locality), Dapitan, Davao, Zamboanga. NEGROS, Cuernos Mountains. LUZON, Laguna, Mount Maquiling and Los Baños: Bataan, Mount Limay. All from Baker.

Megachile robbii Ashmead.

Megachile robbii ASHMEAD, Proc. U. S. Nat. Mus. (1904), 28, 128; COCKERELL, Proc. U. S. Nat. Mus. (1909), 36, 415.

LUZON, Manila. I examined Ashmead's type in the United States National Museum.

Megachile albobarbata Cockerell.

Megachile albobarbata COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 16, 488.

MINDANAO, Dapitan (from *Baker*). Allied to the Australian *M. mystacea* (Fabricius).

Megachile navicularis sp. nov.

Male.—Length, 7.5 to 9.5 millimeters, rather slender; black, with pale ocherous pubescence, pure white on lower part of cheeks and pleura and on femora (dense on underside of anterior pair); anterior coxæ with short spines; anterior tarsi fringed with long white hair behind, the basitarsus black with a long yellow boat-shaped process, extending its whole length and a short distance beyond its end, small joints of the tarsus ferruginous; face covered with pale golden or whitish hair; antennæ black, simple; vertex very densely and minutely punctured; mesothorax and scutellum dull and granular; no distinct hair band in scutello-mesothoracic suture; tegulæ reddish, fuscous basally; wings dusky; abdomen with apical and subbasal pale hair bands, but no subbasal one on second segment; fifth segment with basal two-thirds covered with whitish tomentum; sixth densely covered dorsally with pale yellow tomentum, the transverse keel denticulate and emarginate in middle.

LUZON, Laguna, Mount Maquiling (from *Baker; 7452*, type; *7451*). This species looks like *M. subrixator*, but it is easily distinguished by the anterior legs.

Megachile structilis sp. nov.

Male.—Length, about 12 millimeters; parallel-sided; black, with the anterior tarsi broad and thick, clear ferruginous, having posteriorly a short fringe of white hair; hair above pale fulvous, fuscous on vertex and disk of mesothorax; mandibles tridentate; cheeks beneath with pure white hair, upper margin of clypeus straight, shining; antennæ black, very long and slender; eyes brown; mesothorax closely and very finely punctured, but shining between the punctures; hair of thorax above long and abundant, especially posteriorly; tegulæ small, very dark brown; wings dusky translucent; anterior coxæ with large stout spines; middle and hind tarsi fringed with long white hair in the manner of *M. laticeps;* joints of middle and hind tarsi thickened; abdominal bands fulvous, apical and basal, the fifth segment almost entirely covered with pale fulvous tomentum, with black hairs interspersed; sixth similarly covered, with a median longitudinal ridge above, the apical transverse keel very broadly rounded, feebly crenulate, not distinctly notched.

LUZON, Laguna, Los Baños (*Baker 6302*). Resembles *M. laticeps*, but easily known by the structure of the anterior legs. Male *laticeps* has the anterior coxæ unarmed.

Megachile laticeps Smith.

Megachile laticeps SMITH, Cat. Hym. Brit. Mus. (1853), 1, 183; COCKERELL, Ann. & Mag. Nat. Hist. (1914), VIII, 13, 430.

LUZON, Laguna, Los Baños (*Baker 1790*); Mount Maquiling (*Baker 7453*). Only males have been received. Smith described the species from a male from the Philippine Islands. According to Meade-Waldo, the insect described by Cameron (1905) from Borneo as *M. varidens* is identical with *M. laticeps*.

Megachile candentula Cockerell.

Megachile candentula COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 532.

MINDANAO, Dapitan (*Baker 3140, 3144*).

Megachile merrilli sp. nov.

Male.—Length, nearly 9 millimeters; parallel-sided; black, the small joints of anterior tarsi distinctly swollen and brownish; hair of vertex, scutellum, and posterior two-fifths of mesothorax long and black; of face yellow, of cheeks and most

of thorax white, on anterior part of mesothorax thin and white, the tuft below tegulæ slightly yellowish; antennæ long and slender, black; vertex densely punctured; mesothorax and scutellum very densely and minutely punctured, but glistening; tegulæ black; wings dusky; abdomen rather short, shining, with feeble white hair bands, the basal ones very thin, the apical only at sides; keel of sixth segment feebly developed, broadly rounded, obtusely emarginate, with a depression above the emargination. Anterior coxæ without spines.

LUZON, Laguna, Mount Maquiling (*Baker*). This and the next are named after naturalists whose contributions to the knowledge of the Philippine biota can never be forgotten.

Megachile mcgregori sp. nov.

Male.—Length, about 10.5 millimeters; similar to *M. merrilli*, but larger and also differing thus: Hair of thorax above warm ocherous, without black; tegulæ ferruginous; wings with a distinct reddish tint; punctures of mesothorax quite distinct under a lens; anterior tarsi entirely black; keel of sixth abdominal segment broadly emarginate. The anterior coxæ are without spines.

LUZON, Laguna, Mount Maquiling (*Baker 7450*).

Genus **ANDROGYNELLA** Cockerell

Female wholly without ventral scopa, but with sting well developed; antennæ of female 13-jointed and anterior coxæ spined, as in male.

Androgynella subrixator sp. vel forma nov.

Female.—Nearly 9 millimeters long, with the general character of *Megachile subrixator* from the same locality, but abdomen smooth beneath, without any ventral scopa, though the form of the abdomen is that of a female and the sting is present; anterior parts, including head, as in male, face covered with yellow hair, antennæ long and 13-jointed, and anterior coxæ with sharp spines. A second specimen, however, has shorter antennæ, which are only 12-jointed.

MINDANAO, Davao (from *Baker*). I should regard these as simple gynandromorphs of *Megachile subrixator*, which they may be, but for the fact that a similar type (*Androgynella detersa* Ckll.) is established as a genuine species in Australia. I have discussed this subject [5] and have shown that the characters in the Australian form are constant in a considerable series. In

[5] *Ann. & Mag. Nat. Hist.* (1911), VIII, 7, 314.

our bee the antennal character is not constant and there is more reason for considering the form an ordinary gynandromorph. Therefore I give it the same specific name as that of the species from which it appears without doubt to have been derived. In discussing *A. detersa*, of which both sexes are known, I wrote as follows:

> Mr. R. E. Turner examined 14 female specimens in his collection, and all had 13-jointed antennæ and wholly lacked a ventral scopa. [It should be added that the anterior coxæ are spined.] It is, therefore, certain that this is a normal condition, and must represent an early stage in the evolution of a parasitic species, like those of *Cœlioxys* and *Stelis*. From the standpoint of genetics, it is an extraordinary case, since the female seems to have dropped her secondary sexual characters and thereby assumed those of the male, which were present in her genetic constitution. It is noteworthy that the sting, a modified primary character, is retained. It appears that in *Megachile* the female is heterozygous for the secondary sexual characters, with the female characters dominant.
>
> Thus a new generic type has been produced by the simple dropping out of one set of characters. It may be objected that the insect is still essentially a *Megachile*, and this is indeed true as regards its major characters, but according to any logical system of classification it must go in a distinct generic group, as otherwise our current definition of *Megachile*, applicable to hundreds of species all over the world, breaks down.

Presumably the male of *Androgynella subrixator* cannot be distinguished from *Megachile subrixator*.

Genus **HERIADES** Spinola

Heriades sauteri philippinensis Friese subsp. nov.

Female.—Like *H. sauteri* Ckll., from Formosa, but more finely punctured on mesothorax and first abdominal segment. Very small bees, a little over 6 millimeters long, with white ventral scopa.

LUZON, Laguna, Los Baños (*Baker 550*), Mount Banahao (*Baker*). Doctor Friese had named this in manuscript as a distinct species, *H. philippinensis;* I publish the name with his permission. It is so close to the Formosan *H. sauteri* that I was at first disposed to consider it identical. Friese very probably bestowed his manuscript name before *H. sauteri* was published.

APPENDIX TO XYLOCOPIDÆ AND CERATINIDÆ

Mesotrichia subvolatilis sp. nov.

Male.—Length, about 21 millimeters; anterior wing, 19; entirely covered with rich orange-yellow (not at all green) hair; apex of abdomen with ferruginous hair, not at all mixed with black; clypeus roughened, with broad median longitudinal and

apical transverse yellowish testaceous bands; labrum with a small basal yellow spot; mandibles with a large light basal spot; scape testaceous beneath; flagellum ferruginous beneath, black above; wings dusky, darker apically, with purple tints; first transverse-cubital nervure rather weak below, but complete; hind tibiæ with a band of bright copper-colored hair; hair of hind tarsi reddened.

MINDANAO, Davao (from *Baker*). *Mesotrichia volatilis* (*Xylocopa volatilis* Smith) was based on a male collected by Wallace at Menado, Celebes. Smith's description agrees well enough with the insect now described to suggest identity, but he fails to give measurements. Maidl records a specimen from Samanga, southern Celebes, and informs us that it is about 30 millimeters long, the anterior wings 24 millimeters, while the first transverse-cubital nervure is obsolete basally. This is manifestly not our species, and since Maidl's insect, coming from Celebes (though indeed from a very different part of the island) is presumably correctly named, a new name is given to the Philippine form. *Mesotrichia euchlora* (Pérez) was also collected at Davao.

Allodape picitarsis Cameron.

A male from Baguio is evidently distinct from *A. marginata*, having the wings brownish, the middle and hind tarsi red, the anterior tarsi pale reddish with the base black. This may be separable from true *picitarsis*, of the Laccadive Islands, but more material is needed.

Allodape mindanaonis Cockerell.

A new locality is Davao, Mindanao (from *Baker*).

Ceratina philippinensis Ashmead.

Additional localities: MINDANAO, Davao. PALAWAN, Puerto Princesa. Both from Baker.

Ceratina tropica Crawford.

Additional localities: LUZON, Laguna, Mount Maquiling. MINDANAO, Davao. Both from Baker.

Ceratina flavolateralis Cockerell.

Male from Mount Maquiling; both sexes from Davao, Mindanao (*Baker 7428, 7429*). The female, not before known, is marked like the male. In the table this species runs in at the end, i^3. Pleura all yellow.

Ceratina dentipes Friese.

Additional localities: MINDANAO, Cagayan and Davao (from *Baker*).

Ceratina bicuneata sp. nov.

Female.—Length, 7 to 8 millimeters; black, with chrome yellow markings as follows: Band across lower part of clypeus (widest in middle and obtusely angular above), transverse supraclypeal band (angular above), two small spots on middle of front, cuneiform lateral marks (broad below, ending above at about level of antennæ), occipital band, ending in a large patch on each side, band on prothorax, tubercles, spot behind tubercles, transverse patch occupying greater part of scutellum (subtrilobed anteriorly and narrowly incised in middle), knees, anterior femora beneath, anterior and middle tibiæ on outer side, and hind tibiæ at base; tibiæ (where not yellow) and tarsi reddish; abdomen with five yellow bands, that on first segment poorly developed, consisting of a median patch and small, almost disconnected, sublateral yellow marks; band on second segment slender, with a large patch at each side, on third narrowed in middle and sublaterally, on fourth and fifth (where the surface is rough) broad in middle; sixth segment with an obscure median yellow spot; scape obscure reddish basally; tegulæ ferruginous; wings dusky translucent; stigma piceous; face and front with very large punctures; upper part of cheeks polished and impunctate; mesothorax with the disk polished and impunctate, the narrow margins and the broad lateral anterior corners with strong punctures, but not roughened; base of mesothorax finely roughened, appearing under the microscope to be covered with longitudinal ridges, except sublaterally posteriorly, where it is very minutely cancellate; abdomen broad.

LUZON, Benguet, Baguio (from *Baker*). Related to *C. lepida, simillima,* and *rugifrons,* but distinguished by the face markings and structure of base of metathorax. In the table of Philippine species it runs to *C. philippinensis,* from which it is easily known by the polished mesothorax, with strong well-separated punctures in the anterior lateral region.

Subgenus **Chloroceratina** novum

Ceratina cyanura sp. nov.

Female.—Length, about 7 millimeters; the slightly dusky wings long and ample; abdomen broad apically, but narrowed to base, making it broadly clavate; head shining dark blue, with pale yellow marks as follows: Large quadrate mark (with

triangular projection below) on clypeus, small transverse mark at each side of clypeus, semilunar lateral marks with a finger-like projection below; labrum pallid, except lower margin; mandibles black, with a reddish band; lower part of clypeus black; front and cheeks polished and impunctate; flagellum mainly pale testaceous beneath, but last two joints dark; mesothorax green, smooth, and polished, feebly punctate anteriorly; rest of thorax black, except for cream-colored marks as follows: Large part of prothorax (including tubercles), broad vertical band (with triangular projection posteriorly) behind tubercles, oblique band behind posterior margin of mesopleura, large mark on scutellum shaped like a bird in flight (but upside down); area of metathorax plicate at base; tegulæ rufous; second submarginal cell a nearly equilateral triangle; legs hairy, mainly piceous, but all the femora and anterior and middle tibiæ pale testaceous beneath; abdomen bright blue, with the bases of the first three segments broadly testaceous; apical segments with black hair.

LUZON, Nueva Vizcaya, Imugan (*Baker 8062*). An entirely unique species, at once known by its remarkable colors and markings. In the previously known Philippine fauna it is closest to *C. benguetensis*, which has a very perceptible green tint on the front, vertex, and mesothorax. *Ceratina benguetensis* also has a bicolored flagellum, and the abdomen is somewhat clavate. The two species form a new subgenus *Chloroceratina* (type *cyanura*), distinguished from *Ceratinidia* by the coloration and the shape of the abdomen.

DESCRIPTIONS AND RECORDS OF PHILIPPINE COCCIDÆ

By ELIZABETH ROBINSON

THREE TEXT FIGURES

DACTYLOPIINÆ

Phenacoccus spinosus sp. nov. Fig. 1*a*, 1*b*.

Female thinly covered with white cottony secretion, about 3 millimeters long, 2.5 broad, slender fragile filaments about 3 millimeters long. Mounted female ovate, 2.5 millimeters long, 1.30 broad, light brown. Antennæ 9-jointed, measurements in microns: (1) 50, (2) 75, (3) 75–77, (4) 55–60, (5) 62.5, (6) 50, (7) 47.5–50, (8) 50–52.5, (9) 72.5–77 (fig. 1*a*).

Legs slender, length of joints in microns are as follows:

Leg.	Coxa.	Trochanter plus femur.	Tibia.	Tarsus.	Claw.
	Microns.	*Microns.*	*Microns.*	*Microns.*	*Microns.*
Middle	100	330	150	82.5	20–22.5
Hind	112.5	397	337.5	102.5	27.5

Claw with a single denticle; digitules slender, no longer than claw. Six rounded caudal lobes bearing hairs about 200 microns long. Six spiny hairs of anal ring, 125 to 138 microns long. Around the body, and equidistant between ventral and dorsal lines, a series of circular areas composed of pores and truncate spines.

Larva ovate, yellow, 1.50 millimeters long, 0.75 broad. Fewer patches of pores and truncate spines. Antennæ 6- or 7- jointed. Entire length of 6-jointed antenna, 235.5 microns; of 7-jointed antenna, 337.5 microns. Length of middle leg in microns: Coxa, 50; trochanter plus femur, 155 to 160.5; tibia, 100 to 110; tarsus, 80; claw, 18 to 22.5 (fig. 1*b*).

LUZON, Laguna, Paete (*R. C. McGregor*), March, 1917, on *Ficus nota* (Blanco) Merr.

Many of the characters resemble those of *Phenacoccus azaleae* Kuwana and *Pseudococcus nitidus* Brain. The large legs and and antennæ of this species differentiate it from both.

FIG. 1. *Phenacoccus spinosus* sp. nov., × 175; *a*, antenna of adult female; *b*, antenna of larva.

Pseudococcus virgatus (Cockerell).

LUZON, Manila, Malate (*McGregor*), April, 1917, on *Hibiscus rosa-sinensis* Linn.: Rizal Province, Fort William McKinley (*McGregor*), April, 1917, on *Bridelia stipularis* (Linn.) Blume.

DIASPINÆ

Hemichionaspis aspidistræ (Signoret).

LUZON, Laguna, Paete (*McGregor*), March, 1917, on the mature fruit of *Areca catechu* Linn.

Aspidiotus cydoniæ Comstock.

LUZON, Manila (*McGregor*), April, 1917, on *Samanea saman* Merr.

Pseudaonidia manilensis sp. nov. Fig. 2.

Female scale circular to subcircular, convex, 1.50 to 1.75 millimeters in diameter, dark brown; exuviæ lateral to subcentral, yellowish brown.

Adult female oval; caudal margin with median lobes heavy, notched on each side, second and third pairs of lobes narrow, transparent, variable in size and shape; fourth lobes represented by small rounded projections followed by a series of rounded projections and spines; bidentate or tridentate plates between the lobes (fig. 2). Circumgenital glands: Anterior laterals of 23 to 25 orifices, posterior laterals 8 to 12. Many tubular spinnerets. On dorsal surface an extensive reticulated patch, oval in outline, composed of irregular spaces.

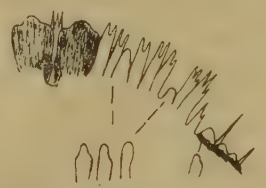

FIG. 2. *Pseudaonidia manilensis* sp. nov., caudal margin of female, enlarged.

In some specimens the lateral lobes resemble those of *Pseudaonidia curculiginis* Green, but that species lacks the tessellated area. The form of the median lobes is different in *Pseudaonidia trilobitiformis* (Green).

LUZON, Manila (*McGregor*), April, 1917, on *Samanea saman* Merr.

Chrysomphalus rossi (Maskell).

LUZON, Laguna, Los Baños (*C. F. Baker*), June, 1916, on *Phalaenopsis* sp.

Greeniella javanensis (Green). Fig. 3.

Aonidia javanensis GREEN, Ent. Mo. Mag. (1880), 16, 31.

LUZON, Laguna, Mount Maquiling (*Baker, 7011*), March, 1914, on *Eugenia* sp.

This determination is based on the characters of the scale and structures of the adult. The species as represented by this material appears to have the characters of the genus *Greeniella*, including the waxy larval horns on female scale and prominent, irregular, variable processes of caudal area (fig. 3) similar to those of the type, *Greeniella cornigera* (Green).

FIG. 3. *Greeniella javanensis* (Green), caudal margin of female, enlarged.

Lepidosaphes gloverii (Packard).

LUZON, Laguna, Paete (*McGregor*), March, 1917, on mature fruits of *Areca catechu* Linn.

Cryptoparlatoria uberifera Lindinger.

Cryptoparlatoria uberifera LINDINGER, Zeits. f. Wiss. Insektenbiol. (1911), 7, 126.

Philippine Islands. On *Artocarpus* and *Mallotus philippinensis*. I have not seen this species.

ERRATA IN COCCIDÆ OF THE PHILIPPINE ISLANDS IN THIS JOURNAL, SECTION D (1917), 12, NO. 1

Page 4: To line 11 add (From the original description.).
Page 8: Line 6 from the bottom should read Type, *Pulvinaria pyriformis* Cockerell.
Page 9: In line 18 from the bottom *for* to *read* and.
Page 15: In the last line *for* (Plate II, fig. 21) *read* (Plate I, fig. 11).
Page 17: In line 11 *for* (Plate IV, fig. 9) *read* (Plate V, figs. 9 and 10).
Page 20: In line 22 add pellucida.
Page 20: In line 9 from the bottom *for* V *read* III.
Page 26: In line 15 *for* exuviæ *read* exuvia.
Page 29: In line 13 *for* Leonard *read* Leonardi.
Page 33: In line 14 *for* circuliginis *read* curculiginis.
Page 34: In lines 8, 9, and 10 *for* "circuliginis" *read* "curculiginis."
Page 37: In line 5 *for* (Plate V, fig. 4) *read* (Plate VI, fig. 3).
Page 43: In line 15 omit the comma after "base."
Page 47: In the first line for *circuliginis* read *curculiginis*.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. *Phenacoccus spinosus* sp. nov., × 175; *a*, antenna of adult female; *b*, antenna of larva.
2. *Pseudaonidia manilensis* sp. nov., caudal margin of female, enlarged.
3. *Greeniella javanensis* (Green), caudal margin of female, enlarged.

NOTES ON JAPANESE LEPIDOPTERA AND THEIR LARVÆ: PART V

By A. E. Wileman

(*London, England*)

TWO COLORED PLATES

HETEROCERA

LYMANTRIIDÆ

Genus **DASYCHIRA** Stephens

Dasychira Stephens, Ill. Brit. Ent. Haust. (1829), 2, 58.

Dasychira conjunctą Wileman.

Plate I, fig. 1, imago, ♂ (figured from the cotype); fig. 2, head.

Japanese name, *yoshino-dokuga.*[1]

Dasychira conjuncta Wileman, Trans. Ent. Soc. London (1911), 270, No. 271, ♂.

Dasychira conjuncta seems to be allied to *D. olga* Oberthür.[2] As a figure of this species was not given when the type was described, I take the present opportunity of figuring it from the drawing of a cotype in my possession. I also append my original description for convenience of reference.

♂. Forewings grey, clouded with darker on the basal and outer marginal areas; antemedial line blackish, inwardly oblique, elbowed at costa, postmedial line blackish, curved and recurved to just below vein 2 where it is connected with antemedial by a black bar, thence outwardly oblique to near the outer angle; marginal line blackish, crenulate, commencing at apex and projected inwards on vein 2; there are indications of a whitish, serrated, submarginal line; fringes grey variegated with paler at the ends of the nervules. Hindwings fuscous with blackish discal dot and marginal line; fringes pale grey flecked with darker between the nervules.

Underside whitish tinged with fuscous especially on the forewings; all the wings have a dusky discal spot and postmedial line.

Expanse 42 mm.

Male type from Yoshino, province Yamato, Honshu, June, 1900.

A series of eleven male specimens taken at Yoshino, province Yamato, in June, 1895, 1899, 1900, and 1901. The series shows but little variation

[1] This species has been named by me in Japanese after the locality where the type was taken, Yoshino, Yamato Province, Honshu.

[2] Oberthür, Etudes d. Entom. (1880), 5, 34, Pl. 2, fig. 1, ♀.

in colour and varies in expanse from 38 mm. to 42 mm. I have never taken a female.

Local distribution. Hondō (Honshū).

Habitat. Japan.

Collection number, 217.

Genus ORGYIA Ochsenheimer

Orgyia OCHISENHEIMER, Schmett. Fur. (1810), 3, 208.

Orgyia thyellina Butler.

Plate I, fig. 3, larva, dorsal view; fig. 4, food plant; fig. 5, larva, lateral view.

Japanese names: *Himeshiromon-dokuga, himetsuno-kemushiga, kotsu-no-kemushi, kenaga-kemushi-chō.*

Orgyia thyellina BUTLER, Trans. Ent. Soc. London (1881), 10, ♂; LEECH, Proc. Zool. Soc. London (1888), 625, No. 218, Pl. 31, figs. 7, 7*a*, ♀ (normal and semiapterous forms); Trans. Ent. Soc. London (1899), 118, No. 410; MATSUMURA, Japanese Injurious Insects [Nihon Gaichūhen (Jap.)] (1899), 49, Pl. 21, fig. 1, imago, ♂; fig. 2, ♀; fig. 3, ova; fig. 4, larva; fig. 5, cocoon; SWINHOE, Trans. Ent. Soc. London (1903), 459; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)], 3d ed. (1910), pt. 2, 30, Pl. 90, imago, ♂, ♀, and larva; Insects Injurious to Fruit Trees [Kwajū Gaichūhen (Jap.)], 5th ed. (1911), 66, 124, Pl. 33, larva, imago; MATSUMURA, Cat. Insect. Jap. (1905), 1, 40, No. 328; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 66, No. 112, Pl. 10, fig. 21, ♂; STRAND, Seitz's Macrolep. Faun. Pal. (1910), 2, 119, Pl. 22*b*, ♂; Pl. 19*c*, ♀ (normal and semiapterous forms).

Notolophus thyellinus KIRBY, Cat. Lep. (1892), 495.

The larva figured (Plate I, figs. 3 and 5) was taken in July (figured July 11), 1901, at Kobe, Settsu Province, Honshu, on wistaria, Japanese name *fuji* (*Kraunhia floribunda* Willd.). This larva died, and no imago was bred from it. I bred specimens from other larvæ compared with my original figure as follows: Two males at Kobe, May 31 and June 16, 1899; two females with normal wings, June 6, 1899, and July 15, 1901; one male, Hakodate, Hokkaido, September 20, 1902. My collector also captured semiapterous females on the cocoon, but I have never bred them from the larva.

The following description is taken from my original figure of the larva:

Larva.—Length, 37 millimeters. Yellow with grayish white lateral hairs; head gray; collar of segment 2 coral red; on each side of head is a long hornlike tuft of grayish black hairs, pointing forward; medial dorsal line grayish black, more or less attenuated on segments 2 and 3, broad on segments 4 to 8, and gradually tapering to segment 12; dorsal brushlike tussocks of

yellowish white hairs on segments 4 to 7; yellow dorsal tubercles on segments 9 to 11; red subdorsal tubercles on segments 2 to 3 and 9 to 12; a spiracular gray stripe, interrupted by red tubercles, emitting hairs; a subspiracular yellowish stripe; a lateral, compact, subspiracular, brushlike tuft of grayish black hairs on segment 6 and of thin fascicles of whitish gray hairs on each segment and anus; a long tuft of pinkish gray hairs pointing backward on segment 12. The larva was common on wistaria at Kobe in 1901. Matsumura says that it feeds upon the pear and other fruit trees. Matsumura [3] records the life history of this species and gives figures of the male and the normal female imago, the ova, the larva, and the cocoon. He says that—

> The species is double brooded and hibernates in the ova stage. The first brood appears in July and August, the second brood in September and October.

Sasaki [4] also describes the life history and gives figures of the male and the normal female imagoes and of the larva. He says that the first brood of the larva appears in May and June and the second brood in August and September. The larva is full-grown by the middle of June and September, and the imago emerges at the end of June and October. He gives as food plants mulberry (*kuwa*); wistaria (fuji); dwarf oak, *kunugi* (*Quercus serrata* Thunb.); *ō-kuro-umemodoki* (*Rhamnus japonicus* Maxim. var. *genuina* Maxim.).

> The male flies in the day time like gonostigma Fab. The female does not cover its eggs with hairs from the anal tuft like gonostigma.

Imago.—Leech [5] remarks:

> A fine series, collection Pryer, including four female specimens with well-developed wings, and three examples of the same sex in which the wings are dwarfed, but with the markings reproduced in miniature.
>
> Although very different in coloration, the markings of the female are exactly of the same character as those of the male. In reference to the females with ill-developed wings it should be said that these organs are very similar in appearance to the wings of a moth on its first emerging from the pupa and gives one the idea of arrested development. Instances of this nature are not unknown to the breeder of Lepidoptera, although the cause is not understood. There is nothing to show whether Pryer's specimens of this species were captured or bred; but as the semiapterous form is nearer to typical female *Orgyia* we may reasonably suppose that such forms as that figured are used with *O. thyellina*.

[3] Matsumura, Nihon Gaichūhen (1899), 50, Pl. 21, figs. 1–5.

[4] Sasaki, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)], 3d ed. (1910), pt. 2, 30, Pl. 90.

[5] Leech, *Proc. Zool. Soc. London* (1888), 625.

In this connection I may observe that I have three semi-apterous female forms of this species, taken, whilst seated on their cocoons, from which they had apparently just emerged, by my collector on October 28, 1898. This proves that the curious dimorphic form of the female is not the result of breeding, but that it is due to natural causes. It would be interesting to elucidate the reasons for this dimorphism of the same sex which, so far as I am aware, does not occur in any other species of the genus *Orgyia* in Japan.

Local distribution.—Honshu: Tokyo, Musashi Province (*Fenton*); Yokohama, Musashi Province (*Pryer*); Oiwake, Shinano Province (*Pryer*); Kobe, Settsu Province, May, June, July, October (*Wileman*); Asamayama, Shinano Province, August (*Wileman*); Hoshikawa, Musashi Province, June (*Wileman*). Kyushu: Shimo-shiiba, Hyuga Province, July (*Wileman*); Matsuo, Higo Province, July (*Wileman*). Shikoku: Higoshi-no-kawa, Ohoki, Iyo Province, July (*Wileman*); Iyamura, Awa Province, October (*Wileman*). Hokkaido (Yezo): Hakodate, Oshima Province, September (*Wileman*).

Time of appearance.—Larva, May to September; imago, May to October. Double-brooded.

Matsumura records the species from Honshu and Hokkaido and says that it is common at Sapporo, Ishikari Province, Hokkaido.

Genus **CIFUNA** Walker

Cifuna WALKER, Cat. Lep. Het. (1855), 5, 1172.

Cifuna locuples Walker.

Plate I, fig. 6, larva of *Cifuna confusa* Bremer.

Japanese names, *mame-dokuga* and *kumogata-kuchiba*.

Cifuna locuples WALKER, Cat. Lep. Het. (1855), 5, 1173; BUTLER, Ill. Typ. Lep. Het. (1878), 2, 18, Pl. 27, fig. 6, ♀; LEECH, Proc. Zool. Soc. London (1888), 632, No. 247; HAMPSON, Moths India (1892), 1, 446; Trans. Ent. Soc. London (1899), No. 421; STAUDINGER and REBEL, Cat. Lep. Pal. (1901), 1, 115, No. 897; MATSUMURA, Cat. Insect. Jap. (1905), 1, 40, No. 230; STRAND, Seitz's Macrolep. Faun. Pal. (1911), 2, 121, Pl. 19*d*, ♀.

Artaxia confusa BREMER, Lep. Ost.-Sib. (1864), 42, Pl. 4, fig. 5, ♂; STAUDINGER, Rom. Mém. Lép. (1892), 6, 303 (larva); STAUDINGER and REBEL, Cat. Lep. Pal. (1901), 115, No. 897*a*; SWINHOE, Trans. Ent. Soc. London (1903), 479; MATSUMURA, Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 61, No. 102, Pl. 10, fig. 10, ♂; NAGANO, Nawa's Insect World [Konchū Sekai (Jap.)] (1909), 13, 311, Pl. 15, figs. 1–13; STRAND, Seitz's Macrolep. Faun. Pal. (1911), 2, 121 (larva).

The larva figured (Plate I, fig. 6) was taken in May (figured May 17), 1901, at Yoshino, Yamato Province, Honshu, on *enoki* (*Celtis sinensis* Pers.). No imago was bred from this larva, but a male imago of form *confusa* Bremer, the larva of which was compared with my original figure, emerged on June 12, 1901. Two other female imagoes of the form *confusa* emerged from similar larvæ on June 18 and August 11, 1901, respectively. I also bred it at Hakodate, Hokkaido, on July 29, 1902.

Larva.—Strand [6] says:

> The larva [of *confusa* Brem.] is not unlike that of *fascelina* L. with long hairy brushes; those near the head yellow with darker hairs in the center; on low-growing plants, especially on vetches (Graeser).

Staudinger [7] also gives a short but inadequate description of the larva. Matsumura says that it feeds upon *daizu* (*Glycine hispida* Maxim); fuji, wistaria (*Kraunhia floribunda* Taub.); utsugi (*Deutzia scabra* Thunb.). The following description is taken from my original description of the larva:

Larva.—Length, 47 millimeters. Yellowish gray; dorsal medial black stripe ill defined from segments 2 to 8 (counting head as segment 1), broadly defined from segments 9 to 12, bordered on each side by a yellowish subdorsal line; two moderately long, blackish gray subdorsal tufts of hair pointing forward from large tubercles on segment 2; between the black medial and yellow subdorsal stripes there is a series of subdorsal tubercles on segments 2 to 4 and 7 to 12, which, with the exception of that on segment 2, emit short whitish gray spinelike hairs; laterally yellowish gray with a brownish yellow tubercle emitting small fascicles of gray hairs on each segment mid-laterally from segments 3 to 12; a spiracular line of similar tubercles and fascicles of thicker gray hairs, the fascicles on segments 5 and 6 being blacker and longer; two yellow medio-dorsal, cup-shaped tubercles on segments 9 and 10; four deep ruddy-brown brushlike tussocks of hair on segments 5 to 8; a short black brushlike tuft, pointing backward on segment 12; two longer black tufts on anal segment pointing posteriorly; anal segment yellow.

Nagano [8] gives in Japanese a long description of the metamorphoses of *Cifuna locuples* Walker, accompanied by descriptions and figures of the ova, the larva, the cocoon, the pupa, and the imago. His description seems to agree with mine in so far as

[6] Strand, Seitz's Macrolep. Faun. Pal. (1911), 2, 121.

[7] Staudinger, Rom. Mém. Lép. (1892), 6, 303.

[8] Nagano, *Nawa's Insect World* (Konshū Sekai) (1909), 15, 311, Pl. 15, figs. 1–13.

I am able to follow the Japanese text. He took larvæ on May 19 on *yoshi* (? *Phragmites communis* Trin. var. *longivalvis* Miq.) and on utsugi (? *Deutzia scabra* Thunb.). Those on utsugi pupated on May 26, and the imagoes emerged on June 7. The imago of one larva taken on ibara also emerged on June 15. From these imagoes he obtained a pair, which copulated, and from the ova laid by the female young larvæ emerged on June 18. These pupated on July 10, and imagoes emerged on July 22. From this he deduces that there are two broods in Gifu (Honshu) and that there may possibly be three broods, the ova probably hibernating. He says that the larva causes some injury to such cereals as barley. My experience with the larva is that it is more or less polyphagous.

Imago.—The type of *Cifuna locuples* Walker is, according to Butler, a female, not a male as described by Walker, and comes from Silhet, India. The type of *Artaxia confusa* Bremer is figured as a male, but Bremer does not give the sex in his description. It was discovered by Radde in the Bureja Mountains and Ussuri, both in eastern Siberia.

Local distribution.—Honshu: Oiwake, Shinano Province (*Pryer*); Yokohama, Musashi Province (*Pryer*); Yoshino, Yamato Province, June, August (*Wileman*); Nikko, Shimotsuke Province, July, August (*Wileman*); Kobe, Settsu Province, June, August (*Wileman*). Hokkaido: Hakodate, Oshima Province, June (*Leech, Andrews*). Matsumura records *confusa* Bremer from Hokkaido and Honshu.

Time of appearance.—Larva, May; imago, June to August.

General distribution.—*Cifuna locuples:* India; southern and central China (*Strand*). *Cifuna confusa:* Eastern Siberia, Amurland; Korea; Japan (*Strand*).

Genus LYMANTRIA Hübner

Lymantria HÜBNER, Verz. Bek. (1827), 160.

Lymantria mathura Moore.

Plate I, fig. 7, larva. Larva of *Lymantria aurora* Butler, ♀.

Japanese name, *kashiwa-maimai.*

Lymantria mathura MOORE, Proc. Zool. Soc. London (1865), 806; LEECH, Trans. Ent. Soc. London (1899), 128, No. 433; HAMPSON, Moths India (1892), 1, 464; STAUDINGER and REBEL, Cat. Lep. Pal. (1901), 1, 117, No. 930; SWINHOE, Trans. Ent. Soc. London (1903), 489; MATSUMURA, Cat. Insect. Jap. (1905), 1, 43, No. 359; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 46, No. 75, Pl. 7, fig. 6, ♀; STRAND, Seitz's Macrolep. Faun. Pal., 2, 128, Pl. 20*e*, ♀.

Lymantria aurora BUTLER, Ann. & Mag. Nat. Hist. (1878), IV, 20, 403; Ill. Typ. Lep. Het. (1878), 2, 11, Pl. 24, fig. 5, ♀; PRYER, Trans. Asiat. Soc. Japan (1885), 12, 50, No. 170; STAUDINGER, Rom. Mém. Lép. (1892), 6, 312; MATSUMURA, Japanese Injurious Insects [Nihon Gaichūhen (Jap.)] (1899), 38, Pl. 46, figs. 1 and 2, imago, ♂ and ♀; fig. 3, cocoon; fig. 4, larva; fig. 5, pupa; STAUDINGER and REBEL, Cat. Lep. Pal. (1901), 1, 117, No. 930*a*; SWINHOE, Trans. Ent. Soc. London (1903), 488; STRAND, Seitz's Macrolep. Faun. Pal. (1911), 2, 128, Pl. 20*e*, ♂ and ♀.

Lymantria aurora var. *fusca* LEECH, Proc. Zool. Soc. London (1888), 629, No. 239, Pl. 31, fig. 9, ♂; STRAND, Seitz's Macrolep. Faun. Pal. (1911), 2, 128, Pl. 20*e*, ♂; SASAKI, Insects Injurious to Japanese Trees [Nihon Jumaku Gaichuhen (Jap.)], 3d ed. (1910), Pt. 2, 50, Pl. 98, imago, ♂ and ♀, larva.

The larva figured (Plate I, fig. 7) was taken at Kobe, Settsu Province, Honshu, in June (figured June 19), 1901, on evergreen oak, Japanese name, *kashi* (*Quercus acuta* Thunb.). It pupated on June 22, and a female of form *aurora* Butler emerged from the pupa on July 8. I bred the female form of *aurora* also from a similar larva on July 11, 1901. I have not bred typical *mathura*, so far, from the few larvæ reared. I have also taken the larva on *hazeno-ki* (*Rhus succedanea* L.), at Kosadake-machi, Higo Province, Kyushu. Matsumura gives as food plants the following trees: *Ko-nara* (*Quercus glandulifera* Bl.), *kashiwa* (*Quercus dentata* Thunb.), and *keyaki* (*Zelkowa acuminata* Lind.). I found a larva on kashiwa at Yokohama on July 2.

The larva of *aurora* is an example of procryptic colors affording a general protective resemblance. This is defined by Poulton [9] as "concealment as a protection against enemies, effected by colors which harmonize with the total artistic effect of the immediate environment." The colors of the larva assimilate well with the bark of the trees on which it feeds, and it is often to be seen lying quiescent in some numbers on the trunks of such trees. Besides being protected from attack by its barklike resemblance, it is also protected by its urticating hairs, and on this account it must be handled with caution, or the results may be unpleasant.

The following description is taken from my original figure:

Larva.—Length, 80 millimeters. Grayish brown, bark-colored; head deep brown with lighter streaks; dorsum various shades of light yellowish brown and gray, ringed with lighter whitish gray at the segmental sutures; anal segment whitish gray; a longitudinal, medial, brownish dorsal line, interrupted, more or less, at the segmental sutures and there edged on

[9] Vide *This Journal, Sec. D* (1914), 9, Table I, facing p. 248.

both sides with darker color; transverse, orange dorsal patches on segments 3 and 4 (counting head as segment 1); two small mediodorsal tubercles on segments 10 and 11; one subdorsal series of tubercles on each side of dorsum emitting a few short hairs and running from segment 3 to anal segment; a lateral series of larger tubercles on each side, commencing on segment 2, which emit fascicles of ruddy gray hairs and end at the anal segment; ten long, compact pencils of hair, which are black, shaded with ruddy brown at the base; two (one on each side of the head), which belong to the lateral series of tubercles, point forward from segment 2 beyond the head; two, which belong to the lateral series of tubercles, are situated on each side of segment 12 and curve toward the anus; six are situated on the anal segment, three on each side, pointing posteriorly; the two central ones belong to the subdorsal series of tubercles, and the four lateral ones (two on each side) belong to the lateral series of tubercles.

The hairs urticate severely.

The type of *mathura,* male, is from northern India.

The types of *aurora,* male and female, are from Japan; female, Yokohama (*Jonas*).

Matsumura [10] records the life history of *Ocneria aurora* Butler and gives figures of the male and the female imago, the larva, the cocoon, and the pupa. He says that in Hokkaido it is single-brooded and hibernates in the ovum. The ova, which are covered with hairs from the anal tuft of the female, are deposited on twigs to the number of two hundred or more, and the larvæ emerge in the following spring. The larvæ pupate at the middle or end of July. The imago emerges in the middle of August.

Sasaki [11] also records the life history of *Lymantria aurora* Butler and gives figures of the male and the female imagoes and the larva. He says that the larva appears in May and is full-grown by the end of June. The imago appears in July and then oviposits.

Local distribution.—Honshu: Tokyo, Musashi Province, July; Kawai and Dzushi, Musashi Province, July; Karuizawa, Shinano Province, August; Koyasan, Kishu Province, August (*Wileman*). Kyushu: June (*Wileman*). Shikoku: Ohoki, Iyo Province, July (*Wileman*).

[10] Matsumura, Japanese Injurious Insects [Nihon Gaichūhen (Jap.)] (1899), 38.

[11] Sasaki, Insects Injurious to Japanese Trees [Nihon Jūmuku Gaichūhen (Jap.)], 3d ed. (1910), pt. 2, 50, Pl. 98.

I have taken this species, some specimens of which are apparently referable to *mathura* and others to form *aurora*, in the above-named localities. I also captured many specimens of form *aurora*, female, on the trunks of oak trees in the forests at Jozankei, near Sapporo, Hokkaido (Yezo), in August, 1896. The females were engaged in depositing their ova in the crevices of the bark with their long ovipositors. I also took male *aurora* in abundance at light in the same locality, also var. *fusca* Leech. The species occurs in Hokkaido (Yezo), Honshu, Shikoku, and Kyushu. Matsumura records the species from the same islands under *mathura*.

Leech also gives Loochoo Islands (Ryukyu) and Kurile Islands (Chishima-to) as localities for *mathura* and *aurora*. Swinhoe separates *mathura* and *aurora* and says of *Lymantria aurora* Butler:

> In B. M. collection. 1 ♂, 1 ♀, Japan (types). 1 ♂, 1 ♀, Yesso (=Hokkaido). 4 ♂, Nagahama, (province Omi.), including type fusca. Sunk to mathura in the B. M. collection, but it is a distinct form, the male being uniformly blackish-brown. Butler's type example is an old, worn and faded specimen; whether his female type is really the female of this form is I think very doubtful.

Swinhoe says of *Lymantria mathura* Moore:

> In B. M. collection. 1 ♂ N. India (type). 1 ♂, 1 ♀ Kangra. 1 ♀ Dehra Doon. 2 ♂, 1 ♀, Sikhim. 1 ♀, N. E. Himalayas. 3 ♂, 1 ♀, Loochoo Islands (Ryukyu). 1 ♀ Chefoo, East China. 2 ♀ Omeishan, West China. 2 ♂, 3 ♀ Japan.

Time of appearance.—Larva, May to July; imago, June to August.

General distribution.—Lymantria mathura: Kashmir, Japan, and widely distributed in India (*Strand*); Manchuria (*Matsumura*). *Lymantria aurora:* Eastern Siberia (Amurland), China, Korea, and Japan (*Strand*).

Genus **TOPOMESOIDES** Strand

Topomesoides STRAND, Seitz's Macrolep. Faun. Pal. (1910), 2, 133.

Topomesoides jonasii Butler.

Plate I, fig. 8, pupa, suspended; fig. 9, dorsal view; fig. 10, abdominal view.

Japanese names, *niwatoko-dokuga* and *usuiro-hoshi-ukon*.

Aroa jonasii BUTLER, Ann. & Mag. Nat. Hist. (1877), IV, 20, 402; Ill. Typ. Lep. Het. (1878), 2, 10, Pl. 23, fig. 11, ♂; LEECH, Proc. Zool. Soc. London (1888), 647, No. 318; Trans. Ent. Soc. London (1899), 120, No. 414; MATSUMURA, Cat. Insect. Japan (1905), 42, No. 349; KAMIMURA, Nawa's Insect World [Konchū Sekai (Jap.)] (1906), 10, 495, larva, pupa, imago (black and white woodcut); (1907), 11,

543; MATSUMURA, Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 139, Pl. 13, fig. 20, ♂.

Euproctis jonasi SWINHOE, Trans. Ent. Soc. London (1903), 410.

Topomesoides jonasi STRAND, Seitz's Macrolep. Faun. Pal. (1910), 2, 133, Pl. 19*h* (3), ♂.

Topomesoides gigantea STRAND, Seitz's Macrolep. Faun. Pal. (1910), 2, 133, Pl. 19*h* (4), ♂.

[*Topomesoides.*]—Most closely allied to *Topomesa* Walk., but vein 8 and 9 both terminate at the costal margin, 10 originating closer to the cell than 7, the discocellular of the hindwing is more oblique (the cell anteriorly considerably shorter than posteriorly) and veins 6 and 7 of the hindwing are separated at the base, 7 really originating from the anterior margin of the cell.—Type: T ("Aroa") jonasi Btlr.[12]

The type of *Aroa jonasii*, male, was from Yokohama. (*Jonas.*)

Strand erects a new genus for *jonasii*, which was left by Leech provisionally in *Aroa* with the following remarks:[13]

I have left this species in Aroa although it does not appear to be rightly placed therein, and a new genus will probably have to be made for its reception.

In June, 1901, I found a hairy larva, on an unknown tree, at Myoken-zan, near Kobe, Settsu Province, Honshu, and a female imago, which I identified at the South Kensington Museum as *Aroa jonasii*, emerged some time during the same month from the pupa resulting from this larva. When the imago emerged, I also identified it from Butler's figure.[14] The moth is a common one and has always been well known to me as *Aroa jonasii*. Owing to press of work my artist was unable to figure the larva before it entered the pupal stage, but he figured the pupa on June 20, 1901, in three aspects (Plate I, figs. 8 and 9). I describe the pupa from my original figure as follows:

Pupa.—Dorsum green with a few yellow markings, three on each side; spiracles brownish; wing cases whitish; suspended by a silken pad attached to a leaf of the food plant. Kamimura,[15] a Japanese lepidopterist of Shizuoka, Honshu, who bred imagos of *jonasii* on several occasions, gives figures of the larva, the pupa, and the imago. His figure of the larva resembles in form that of the larva from which my female *jonasii* emerged in June, 1901. However, I am not able to remember anything about the coloration of my larva except that it was dark and hairy. He describes his pupa as follows:

Pupa.—Color bright green; it hangs down attached by two or three

[12] Strand, Seitz's Macrolep. Faun. Pal. (1910), 2, 133.

[13] Leech, *Trans. Ent. Soc. London* (1899), 120.

[14] Butler, Ill. Typ. Lep. Het. (1878), 2, 10, Pl. 23, fig. 11, ♂.

[15] Kamimura, *Nawa's Insect World* (Konchū Sekai) (1906), 10, 497, larva, pupa, imago, ♂.

silken threads; there are so very few of these silken threads that they can scarcely be called a cocoon.

Kamimura does not mention in the text the yellow streaks that appear on the dorsum of the pupa, but he figures them on his pupa. They are noticeable in my figure (Plate I, 9). His pupa is represented as suspended by the tail from a silken pad attached to a small twig. My pupa is represented in the same position, the silken pad being spun on the underside of a leaf of the food plant. This method of pupation seems rather peculiar for a lymantriid and is suggestive of that of a vanessid pupa, but I am informed by Mr. W. Schultze, formerly of the Philippine Bureau of Science, that *Leucoma marginalis* Walker,[16] a Philippine species, has a somewhat similar mode of pupation. The larva of *marginalis* spins a silken pad and also attaches itself to the leaf by encircling its body with a few silken threads, which one might term a rudimentary cocoon. These threads break away, possibly after the pupa has formed, and the pupa is left suspended by the tail from the silken pad. The pupa of *marginalis* somewhat resembles that of *jonasii* in shape and coloration. It is figured by Semper,[17] together with the larva, which is green and very hairy, quite different in color from that of *jonasii*.

Kamimura also expresses surprise at the method of pupation of *jonasii*, as will be perceived from my translation of his original Japanese text, which is given farther on. He states that the pupa hangs down attached by two or three silken threads and that there are so few of these threads that they can be scarcely called a cocoon.

In his figure of the pupa it is represented as suspended by the tail, like a vanessid pupa, from a silken pad attached to a twig, without any silken threads encircling the body, in such a way as to loop it up to the twig. The "two or three silken threads" that he mentions may either refer to the silken pad from which the pupa is suspended or to threads encircling the pupa, which have been severed. However, he does not throw any light upon this point, and it would be interesting to know whether the larva of *jonasii* undergoes its pupal transformation merely suspended from a silken pad. If so, it certainly has the habits of a vanessid larva. I am unable to say whether any silken threads encircled my pupa and attached it also to the leaf in addition to the silken pad. They may have been present and become

[16] Walker, *Journ. Linn. Soc. London* (1862), 6, 128.

[17] Semper, Lep. Phil. Isl. (1902), 6, 473, Pl. O, fig. 1, larva; fig. 2, pupa.

severed. Kamimura says, in writing of the larva of a moth that he names in Japanese *hoshi-usuiro-ūkon,* or the *kama-tsuka* caterpillar (identified by me from his figure of the male imago as the larva of *Topomesoides jonasii*), that he thought that this larva, which he reared in a breeding cage, together with another larva belonging to the family Lymantriidæ, also belonged to the same family. Much to his surprise this larva, instead of spinning a cocoon as an ordinary lymantriid should do, affixed itself by the tail to the top of the breeding cage and passed through the pupal transformation without spinning a cocoon. He, therefore, thought that some mistake had occurred. However, on rebreeding similar larvæ on several occasions in subsequent years imagoes of *Aroa jonasii* always emerged from them.

The larva is described by him as follows:

> Larva fifth stage. Head black and shining; the whole of the body black; black dorsal tubercles on segments 3 and 7; body covered with light brown hairs, which are particularly long from segments 1 to 3 and from segment 10 to anal segment; the central segments of the body, 8 and 9, are chiefly yellow; segments 6 and 7 are not so yellow; segments 4 to the anal segment are marked with yellow spots on the spiracular line; ventrum of last segment is ashy-yellow.
>
> The larva feeds on the Kama-tsuka,[18] if molested it wriggles about and falls down.
>
> * * * the imago emerges at the beginning of May and larvæ in their third or fourth stages are also to be found during the same month. A larva in its fourth stage, taken on 8 May, became dormant on 14 May and changed into the fifth stage on 14 May; it pupated on 29 May and the imago emerged on 7 June.

The food plants of *jonasii* are: *Niwa-toko* (*Sambucus racemosa* L.), also called in Japanese *tazu-no-ki, komo-utsugi,* and *kobu-no-ki.* Kamatsuka is also called *ushi-koroshi* (*Pourthiaea villosa* Dcne.).

Local distribution.—Honshu: Oiwake, Shinano Province (*Pryer*); Yokohama, Musashi Province (*Jonas*); Hoshikawa, Musashi Province, July (*Wileman*); Yoshino, Yamato Province, June (*Wileman*); Nikko, Shimotsuke Province, August (*Wileman*); Myoken-zan, Settsu Province, May (*Wileman*); Hakone, Sagami Province, August (*Leech*). Kyushu: Satsuma Province, May (*Leech*); Nagasaki, Hizen Province, June (*Leech*); Kimbosan, Higo Province, May (*Wileman*). Matsumura records the species from Honshu and Kyushu.

Time of appearance.—Larva and pupa, May and June; imago, May to August.

General distribution.—Japan and Korea (*Matsumura*).

[18] Also called *ushi-koroshi* (*Pourthiaea villosa* Dcne.).

LASIOCAMPIDÆ

Genus COSMOTRICHE Hübner

Cosmotriche HÜBNER, Verz. Bek. Schmett. (1827), 188.

Cosmotriche potatoria Linnæus.

Plate II, fig. 1, larva; fig. 2, head; fig. 3, dorsal aspect.

Japanese name, *take-kareha*.

Bombyx potatoria LINNÆUS, Syst. Nat. (1767), 12, 813; LEECH, Proc. Zool. Soc. London (1888), 628, No. 232; Trans. Ent. Soc. London (1899), 113, No. 397; STAUDINGER and REBEL, Cat. Lep. Phal. (1901), 1, 122, No. 990; MATSUMURA, Cat. Insect. Jap. (1905), 1, 45, No. 368; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 88, No. 149, Pl. 12, fig. 6, ♀; GRÜNBERG, Seitz's Macrolep. Faun. Pal. (1911), 2, 164, Pl. 26*f*, ♂ and ♀.

Odonestis potatoria var. *askoldensis* OBERTHÜR, Etud. d. Ent. (1881), 5, 38; STAUDINGER, Rom. Mém. Lép. (1892), 6, 316; STAUDINGER and REBEL, Cat. Lep. Phal. (1901), 1, 122, No. 990*a*; GRÜNBERG, Seitz's Macrolep. Faun. Pal. (1911), 2, 164, Pl. 26*f*, ♂.

The larva figured (Plate II, fig. 1) was taken in May (figured May 31), 1902, at Hakodate, Oshima Province, Hokkaido, on bamboo grass, Japanese name, *sasa-kusa* (? *Lophatherum elatum* Zoll.). It pupated on July 4, and a female imago emerged on July 31, 1902. This female seems referable to var. *askoldensis* Oberthür. Another male, which emerged at Hakodate on August 4, 1902, from a larva compared with the foregoing figure (Plate II, fig. 1), seems to be nearer to typical *potatoria*, male. Both specimens are undoubtedly forms of *potatoria* Linn., not of *albomaculata* Brem., the larva of which, as Staudinger [19] justly observes, is quite different from that of *potatoria*. Leech [20] remarks:

> In the series of this species from Japan there are specimens which agree exactly with typical *potatoria*, Linn., and others which are most certainly identical with *O. albomaculata*, Brem., whilst between these two forms are aberrations, including a dark one near the variety *askoldensis* of Oberthür, which cannot be satisfactorily referred to either form; these serve as connecting-links and I think prove [21] the identity of *O. potatoria* and *O. albomaculata*.

Grünberg [22] says of *askoldensis*:

> * * * larger and darker than the European specimens. It appears to be confined to the Ussuri district, East Siberia, for specimens from

[19] Staudinger, Rom. Mém. Lép. (1892), 6, 317.

[20] Leech, *Proc. Zool. Soc. London* (1888), 628.

[21] This, I think, is disproved by the difference in the larvæ of *potatoria* and *albomaculata*.—A. E. W.

[22] Seitz's Macrolep. Faun. Pal. (1911), 2, 164.

Chabarovsk and Nicolaievsk, for instance, do not differ from the European form; however, small specimens, similar to the type-form are found also in the Ussuri district.

The following description of the larva of *Odonestis potatoria* Linn. is given by Wilson,[23] and my original figure of the larva (Plate II, fig. 1) agrees well with this description.

> Larva. About three inches long, and hairy; dorsal area blue-grey, minutely irrorated with black, and speckled with bright yellow dots, some of these latter almost form a subdorsal line; on each side of the back is a row of short black tufts of hair; along each side is a series of larger tufts of white hair; above and between these white tufts there are a number of orange-colored spots and streaks; on each side of the second segment are two warts, from which proceed rather long tufts of hair, and there are long tufts of black hairs on the third and twelfth segments; the remaining hairs are pale yellowish-brown; spiracles buff; head speckled with two shades of yellow; legs and claspers hairy. Rolls in a ring when touched. [Great Britain, *Wilson.*]

Grünberg[24] describes the larva of *potatoria* as follows:

> Larva blackish grey with a slight tinge of blue, dorsally with extended irregular yellow spots, which form stripes in very dark specimens; hair of body and head light brown. Dorsal tufts and brushes of hair black. The lateral hair spots white. In young larvæ the dorsal markings are bright orange-yellow. The larvæ emerge in August and first devour part of the egg-shell, afterwards feeding on hard grasses (Carex, Dactylis, Luzula), also on Leontodon. They hibernate after the third change of skin from the end of October, or November, until April, and are ready to pupate in June. The fusiform cocoon is pale yellow, being often attached to the stalks of Sparganium and Phragmites; pupa glossy dark brown, or blackish brown.

The length of my larva is about 70 millimeters, or nearly 2.75 inches.

It will be observed that Grünberg describes the larva as blackish gray with a slight tinge of blue. In my original figure this blue tinge is also slightly perceptible laterally. On segment 8 it is conspicuous, as just above the proleg on this segment a narrow transverse blue line commences, which encircles the body from side to side (Plate II, figs. 1 and 3).

Pupa.—The pupa is inclosed in a fusiform, dirty whitish brown cocoon of leathery texture attached to the stem of bamboo grass (sasakusa).

Local distribution.—Specimens of *potatoria* from the following localities are in my collection:

[23] Wilson, Larvae of British Lepidoptera (1880), 75, Pl. 15, figs. 1, 1*a*.
[24] GRÜNBERG, Seitz's Macrolep. Faun. Pal. (1911), 2, 164.

Honshu: Nikko, Shimotsuke Province, July 14, 1893, one male. Hokkaido: Hakodate, Oshima Province, August 4, 1902, one male, bred; July 31, 1902, one female, bred (=? var. *askoldenis*); Junsai Numa and Tobetsu, Oshima Province, July, two males; Teshio, Teshio Province, July, one male; July 11, 1899, one female.

Time of appearance.—Larva, May; imago, July and August.

General distribution.—"Distributed from Japan over Siberia, Russia, Central and Northern Europe to Southern Italy and Spain; in the north to Finland." (*Grünberg.*)

Cosmotriche albomaculata Bremer.

Plate II, fig. 4, larva (form 1); fig. 5, food plant; fig. 6, larva (form 2); fig. 7, head; fig. 8, dorsal aspect; fig. 9, dorsal aspect of anal segment; fig. 10, larva (form 3); fig. 11, head; fig. 12, dorsal aspect; fig. 13, food plant.

Japanese name, *take-kareha?* [25]

Odonestis albomaculata BREMER, Bull. l'Acad. Pétr. (1861), 3; Lep. Ost. Sib. (1864), 42, Pl. 4, fig. 6, ♂; Pl. 3, fig. 20, ♀; STAUDINGER, Rom. Mém. Lép. (1892), 6, 317; STAUDINGER and REBEL, Cat. Lep. Pal. (1901), 1, 123, No. 991; GRÜNBERG, Seitz's Macrolep. Faun. Pal. (1911), 2, 164, Pl. 26*g*, ♀ (named *albimacula* in plate).

Odonestis potatoria Linnæus, LEECH, Proc. Zool. Soc. London (1888), 628, No. 232 (part.); Trans. Ent. Soc. London (1899), 113, No. 397 (part.); MATSUMURA, Cat. Insect. Jap. (1905), 45, No. 368 (part.); Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909), suppl. 1, 88, No. 149, Pl. 12, fig. 6, ♀ (*potatoria* Linn.), Pl. 12, fig. 8, ♀ (var. *albomaculata*) (part.); SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichuhen (Jap.)], 3d ed. (1910), pt. 3, 118, Pl. 217, larva, pupa, imago, ♂.

Three forms of the larva are figured.

Form 1.—Laterally yellowish in color; length, 63 millimeters (Plate II, fig. 4). This larva was taken at Yoshino, Yamato Province, Honshu, in September (figured September 12), 1900, on *kaya,* a species of reed grass (? *Torreya nucifera* S. & Z.). The larva died, so that no imago was bred from it. I have observed this form on several occasions and think that it is merely a light form of the larva of *albomaculata,* although I failed to breed it. One often sees the larvæ of this species basking in the sun on mountain paths, having crawled down from adjacent bamboo grass for a tour of inspection; they vary much in shades.

[25] Matsumura gives this name to both *C. potatoria* Linn. and *C. albomaculata* Brem., as he regards the latter species as a variety of *potatoria.*

Form 2.—Laterally purplish gray; length, 66 millimeters (Plate II, figs. 6 to 9). This larva was taken at Hakodate, Oshima Province, Hokkaido (Yezo), in June (figured June 21), 1902, on bamboo grass, Japanese name, sasa-kusa (? *Lophatherum elatum* Zoll.). It pupated on July 4, and a male imago of *albomaculata* Bremer emerged on August 3, 1902. One male and two females were also bred from larvæ compared with this figure (Plate II, fig. 6). The male of these three specimens emerged on August 11, and the two females on July 31 and August 6, 1902, respectively. In the male the upper spot of the forewing is almost obsolete, being a mere dot (much smaller than in Bremer's figure); otherwise these three specimens agree well with his figures of the male and the female. The larva with the purplish gray sides is the commonest form met with, and I have frequently bred *albomaculata* from it.

Form 3.—Dark form; length, 71 millimeters (Plate II, figs. 10 to 12). This larva was taken at Hakodate in August (figured August 11), 1902, also on bamboo grass like the larva of form 2. It died before pupation, so that no imago was bred. This form (fig. 10) is nearer than forms 1 and 2 (Plate II, figs. 4 and 6) to the very dark larva of *potatoria* Linn., which is figured by me (Plate II, fig. 1).

Pupa.—The pupa is inclosed in a fusiform yellow cocoon of leathery texture, which is attached firmly to the stems of sasa (bamboo grass), kaya (reed grass), or various other grasses. The cocoon is smaller than that of *C. potatoria,* which is dirty whitish brown. Both the larva and the cocoon of *albomaculata* urticate to a slight extent.

Some controversy arose between Leech [26] and Staudinger [27] as to whether *albomaculata* should be considered a separate species distinct from *potatoria* Linn. Leech included *albomaculata* as a synonym of *potatoria;* while Staudinger maintained that it was a distinct species, some of his proofs being based upon the difference between the larvæ of the two species.

As will be seen by a comparison of the figures of the larva of *C. potatoria* Linn. and the larva of *C. albomaculata* Brem., forms 1, 2 and 3, there is a considerable difference between the larvæ of the two species, and I am inclined to indorse Staudinger's opinion as to the claim of *albomaculata* to specific rank.

[26] Leech, *Trans. Ent. Soc. London* (1899), 113.
[27] Staudinger, Rom. Mém. Lép. (1892), 6, 317.

Staudinger gives the following description of the larva of *C. albomaculata,* which agrees best with my original figure of the larva, form 2 (Plate II, fig. 6).

> The larva of albomaculata, of which Christoph sent me a very good prepared specimen, is very different from that of potatoria, especially differing also from those of potatoria of the Amur region of which I have two good specimens from Dörries. These are as dark as the darkest larvæ found in Europe in which sometimes the yellow spot-stripes "on the upper side appear very strongly marked almost like stripes. The larva of albomaculata has large, quadrate, orange-brown dorsal spots, edged around with white, on which stand four pairs of black hair tufts which are much shorter than in potatoria. Laterally (from the spiracles) and below the larva is brownish, also the legs. Here, in potatoria everything is dark, only laterally are there small orange stripes which are clothed below with white, or yellow, woolly hairs."

Grünberg [28] describes the larva of *albomaculata* as follows:

> Larva with large orange-brown dorsal spots edged with white, and four tufts of hair at each side on segments 4 to 10 respectively, these being still shorter than in potatoria; laterally and ventrally brownish. Habits as in potatoria, likewise the shape and color of the cocoon.

Sasaki [29] gives descriptions and figures of the larva, the cocoon, and the male imago. He says that the larva, which feeds upon bamboo, appears about the middle of May. It is full-grown in June, and the imago emerges at the end of the same month.

Local distribution.—Common in Hokkaido (Yezo) and Honshu. Matsumura records *potatoria,* with which he includes *albomaculata* as a variety, from the same islands. I have in my collection six males and ten females of *albomaculata* captured and bred at the following localities: Tokyo, Musashi Province, and Kobe, Settsu Province, both in Honshu, and Hakodate, Oshima Province, Hokkaido, two males and nine females bred from larva of form 2, in June, July, and August. Yoshino, Yamato Province, Honshu, and Hakodate, Hokkaido, four females taken in June and July. Nikko, Shimotsuke Province, one female, taken in August.

Time of appearance.—Larva, May, June, July?, August, and September; imago, June to August.

General distribution.—Eastern Siberia (southern Amurland); Korea; Japan. (*Grünberg.*)

[28] Seitz's Macrolep. Faun. Pal. (1911), 2, 164.

[29] Sasaki, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)], 3d ed. (1910), pt. 3, 118, Pl. 217.

EUPTEROTIDÆ

Genus APHA Walker

Apha WALKER, Cat. Lep. Het. (1855), 5, 1180.

Apha tychoona Butler.

Plate II, fig. 14, larva; fig. 15, head; fig. 16, dorsal aspect; fig. 17, food plant.

Japanese name, *obi-ga*.

Apaha tychoona BUTLER, Ent. Month. Mag. (1878), 14, 207; Ill. Typ. Lep. Het. (1878), 2, 18, Pl. 27, fig. 5; PRYER, Trans. Asiat. Soc. Japan (1885), 12, 51, No. 183; LEECH, Proc. Zool. Soc. London (1888), 627, No. 224; Trans. Ent. Soc. London (1898), 273, No. 28; MATSUMURA, Cat. Insect. Jap. (1905), 1, 46, No. 379; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1901), suppl. 1, 89, No. 151, Pl. 12, fig. 9, ♀; GRÜNBERG, Seitz's Macrolep. Faun. Pal. (1911), 2, 185, Pl. 29*e*, ♂, 29f, ♀; NAGANO, Nawa's Insect World [Konchū Sekai (Jap.)] (1911), 15, 91, Pl. 6, figs. 1–12; fig. 1, imago, ♂; fig. 9, larva; fig. 11, pupa, ♀; fig. 10, cocoon.

The larva figured (Plate II, fig. 14) was taken in August (figured August 14), 1902, at Hakodate, Oshima Province, Hokkaido (Yezo), on *shiro-utsugi*, also known as *kogome-utsugi* (*Stephanandra flexuosa* S. and Z.). Matsumura gives *utsugi* (*Deutzia scabra* Thunb.) as the food plant. This larva died, but I bred two male and one female imagoes from similar larvæ on August 19 and 23, 1902. The larva is very common at Nikko, Shimotsuke Province, Honshu, altitude 457 meters (1,500 feet) on utsugi, where I have taken it in some numbers in July and August. When molested it shakes its head violently from side to side.

The following description of the larva is taken from my original figure: Length, 50 to 55 millimeters. Head ruddy-brown with two white streaks on each lobe. Body blackish, clothed dorsally and laterally with dense fascicles of ruddy-brown hairs; subdorsal and midlateral lines of interrupted ochraceous-gray streaks; subspiracular grayish white patches on each segment between the fascicles of hair from 4 to 12; spiracles white; legs brown.

Pupa.—The pupa is inclosed in a loose, hairy cocoon.

Imago.—The imago varies greatly in color, as I have specimens showing the following shades: Whitish brown, grayish brown, olive-brown, purple-brown, and yellow.

Nagano gives descriptions and figures of the imago, the pupa, the larva, and the cocoon and structural details of the imago. He states that he took a larva of *Apha tychoona* on *sui-kazura*

(*Lonicera japonica* Thunb.), at the commencement of June, and that it commenced to spin its cocoon on June 14; on June 17 it changed into a pupa, and the imago emerged on July 5. He thinks that it is probably single-brooded and that it hibernates as an ovum.

Local distribution.—Hokkaido: Hakodate, Oshima Province, August (*Wileman*). Honshu: Nikko, Shimotsuke Province, August (*Wileman*); Tokyo, Musashi Province, July, September, October (*Wileman*). Kyushu: Nakato, Hyuga Province, July (*Wileman*). Matsumura records the species from Hokkaido, Honshu, Shikoku, and Kyushu.

Time of appearance.—Larva, June, July, and August; imago, July to October. Single- or double-brooded (?).

General distribution.—Japan only (*Grünberg*). Leech records it from Japan and from central and western China.

ILLUSTRATIONS

[Drawings by Hisashi Kaidō.]

Plate I

Figs. 1 and 2. *Dasychira conjuncta* Wileman.
1, imago, male (figured from the cotype); *2*, head.
3 to 5. *Orgyia thyellina* Butler.
3, larva, dorsal view; *4*, food plant; *5*, larva, lateral view.
Fig. 6. *Cifuna confusa* Bremer, larva.
7. *Lymantria aurora* Butler, larva, female.
Figs. 8 to 10. *Topomesoides jonasii* Butler.
8, pupa, suspended; *9*, dorsal view; *10*, abdominal view.

Plate II

Figs. 1 to 3. *Cosmotriche potatoria* Linnæus.
1, larva; *2*, head; *3*, dorsal aspect.
4 to 13. *Cosmotriche albomaculata* Bremer.
4, larva (form 1); *5*, food plant; *6*, larva (form 2); *7*, head; *8*, dorsal aspect; *9*, dorsal aspect of anal segment; *10*, larva (form 3); *11*, head; *12*, dorsal aspect; *13*, food plant.
14 to 17. *Apha tychoona* Butler.
14, larva; *15*, head; *16*, dorsal aspect; *17*, food plant.

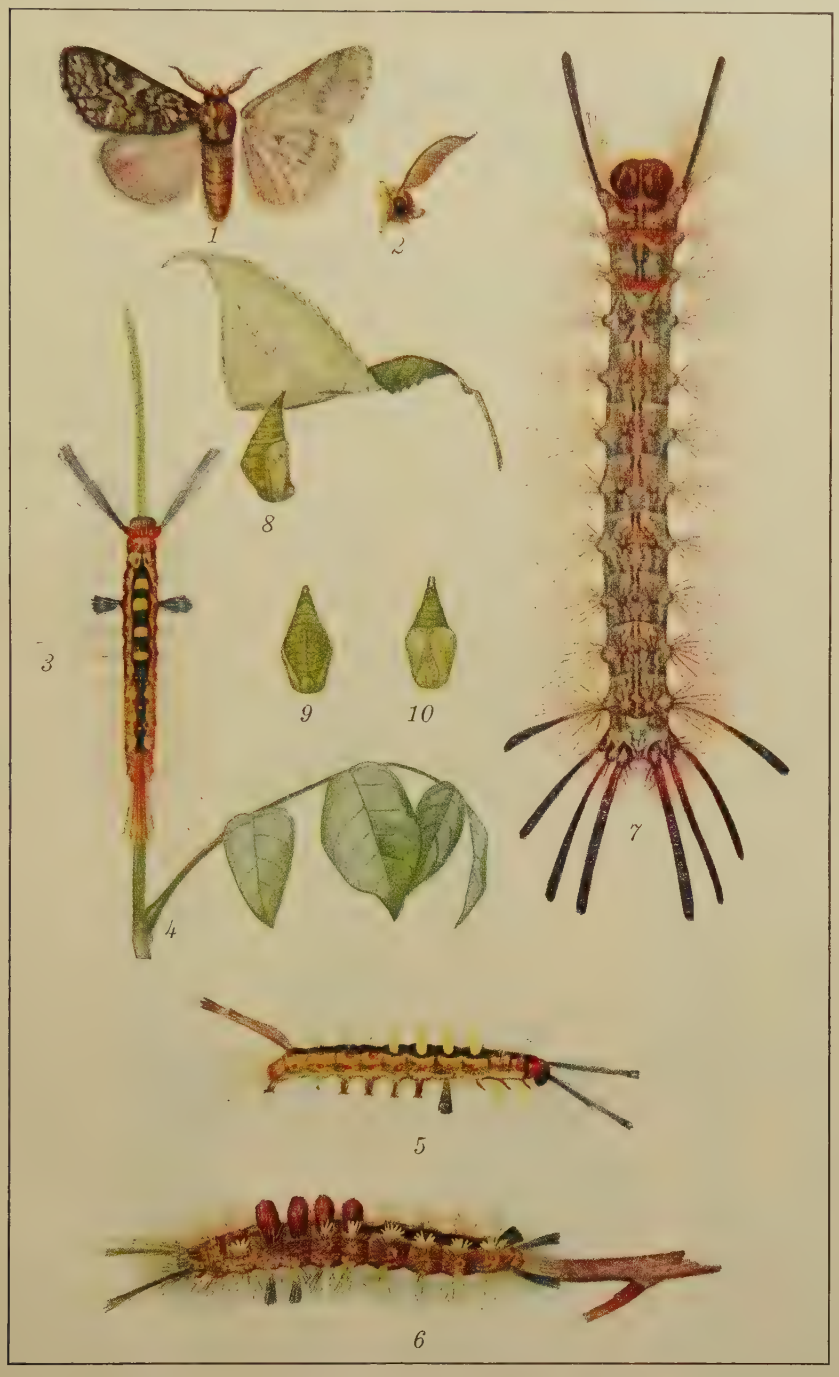

PLATE 1. DASYCHIRA CONJUNCTA, ORGYIA THYELLINA, CIFUNA CONFUSA, LYMANTRIA AURORA, AND TOPOMESOIDES JONASII.

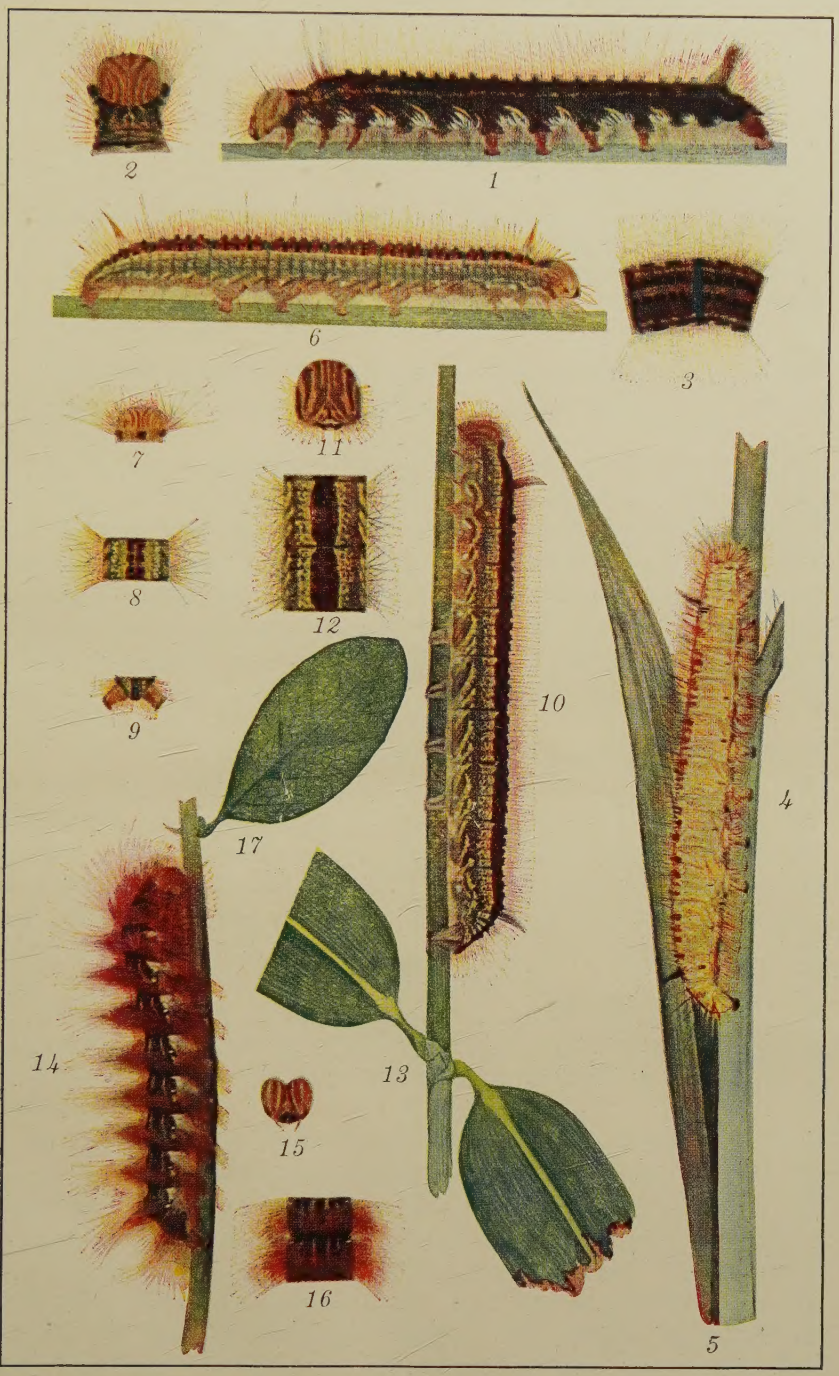

PLATE II. COSMOTRICHE POTATORIA, C. ALBOMACULATA, AND APHA TYCHOONA.

REVIEW

Outlines | of | Comparative | Anatomy | of | Vertebrates | by | J. S. Kingsley | professor of zoölogy in the University of Illinois | second edition, revised | with 406 illustration | largely from original sources | Philadelphia | P. Blackiston's Son & Co. | 1012 Walnut Street. Cloth, pp. i–x—1–449. Price, $2.50 net.

This most excellent work recently came to hand for a review, although the first edition had been seen earlier and the second edition used.

Beginning as he does with an introductory treatment of embryology and histology, the author paves the way in a pleasing and helpful way for the study of the integument, the skeleton, the muscular system, nervous system, sensory organs, digestive organs, respiratory organs, organs of circulation, and the urinogenital system of vertebrates, and he finishes the treatment with a discussion of the nutrition and respiration of the embryo, fœtal envelopes, a bibliography, a glossary, and a table of the roots of technical terms.

A word may be said regarding the attitude of the writer toward the student and toward the subject matter concerned. The work as we understand it is designed to be helpful to the student who is just beginning the study of comparative anatomy and also to be of value to the advanced student. The author has not feared being criticized for repeating certain fundamental facts for the benefit of the person with little preparation; still the work contains thorough and exhaustive treatments of the various structures described. A very admirable feature is the clearness with which all statements and explanations are made, and the profusion of illustrations adds greatly to the value of the work.

In whatever part of the book one reads, the same breadth of scope is found and consequently satisfactory treatment of the subject. Take, for example, the air, or swim, bladder. Its origin, development, and functions are thoroughly discussed, not only in one animal form, but in several forms. Immediately following the swim bladder there is, in its proper order, a discussion of the air-ducts and lungs. The origin, development, and functions are taken up comparatively in a very exhaustive

manner. The same treatment of the circulatory system of various vertebrates is given a large place in the book.

These few structures are mentioned to serve as examples of the method of treatment of all structures, and they illustrate the thorough and exhaustive method used throughout the whole volume. What is true of the structures cited is equally true for the various structures treated.

Because of the pleasing and thorough manner in which the book is written, we feel like giving it our hearty indorsement, and in spite of any minor defects the work commends itself strongly to us.

ARTEMAS L. DAY.